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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
25/04/2007	Final report	07/01/2005-12/31/2006

4. TITLE AND SUBTITLE
Strategic Partnership for Research in Nanotechnology

5a. CONTRACT NUMBER
FA9550-05-1-0420

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Rice University
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
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Room 713
Arlington, VA 22203-1964
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10. SPONSOR/MONITOR'S ACRONYM(S)
AFOSR

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
AFRL-SR-AR-TR-07-0144

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution Statement A: unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Our SPRING III activities concentrated this year on mass spectrometry, a new MALDI system and an ESI-TOF system. We can now perform high resolution nanoparticle analysis along with protein analysis. We consolidated and rehabilitated the Rice X-ray facilities, spending $140K to upgrade the computer controls, software, and adding attachments for temperature control on powder and single crystal systems. An investment toward accessories to the JEOL 200KV FEG Model 2100Finclude a scanning attachment, coupled with energy filtering (GIF) and energy dispersive X-ray spectrometer to convert our high-resolution TEM to a fully analytical scanning transmission electron microscope. Minor systems purchased: a Malvern Zetasizer, a Colloidal Dynamics electrokinetic analyzer (ZetaCAD), a Zeiss TIRF microscope and camera modifications for a NIR microscope, a ULS Laser Engraving and Cutting System, a Z Corporation Rapid Prototyping Printer System and an upgrade to the computers and software for two AFMs. Some funding supported the SPRING III Research Conference in October here at Rice University.

15. SUBJECT TERMS
Nanotechnology, Equipment, Partnership, Collaboration

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*

FINAL REPORT OF THE PROPOSAL "STRATEGIC PARTNERSHIP IN RESEARCH FOR NANOTECHNOLOGY (SPRING)

07/01/2005 – 12/31/2006

GRANT NUMBER: AFRL (AFOSR) FA9550-05-1-0420
PRINCIPAL INVESTIGATORS: Douglas Natelson and Wade Adams
INSTITUTION: Rice University

Summary

Our SPRING III activities concentrated this year on mass spectrometry, upgrading two antiquated machines with a new MALDI system and an ESI-TOF system. Purchases are detailed in the table below. We upgraded our support staff, as well, after the departure of our previous MS staff scientist (MS level), and gained an outstanding PhD-level mass spectroscopist from the University of Washington. We also consolidated our mass spec systems to a new lab with room to grow as we accommodate not only the physical science but also the biological science-oriented mass spec research. We are now able to perform high resolution nanoparticle analysis along with protein analysis. With the addition of a new X-ray scattering staff scientist, we also consolidated and rehabilitated the Rice X-ray facilities, spending $140K to upgrade the computer controls, software, and adding attachments for temperature control on powder and single crystal systems. An investment in accessories to the JEOL 200KV FEG Model 2100F is a scanning attachment, coupled with energy filtering (GIF) and energy dispersive X-ray spectrometer to convert the high-resolution TEM purchased with SPRING II money to a fully analytical scanning transmission electron microscope. The balance of this investment will be funded with SPRING IV monies. This will complete the upgrading of our microscopy facilities to a state-of-the-art electron imaging facility. Minor systems also purchased included a Malvern Zetasizer, a Colloidal Dynamics electrokinetic analyzer (ZetaCAD), a Zeiss TIRF microscope and camera modifications for a NIR microscope, a ULS Laser Engraving and Cutting System, a Z Corporation Rapid Prototyping Printer System, a Leica Vibratome and an upgrade to the computers and software for two AFMs. Some funding supported the SPRING III Research Conference in October, 2005 here at Rice University in Houston. All equipment and accessories are part of Rice's Shared Equipment Authority, which makes them available for use both internally to Rice University and externally.

Background

The Strategic Partnership for Research in Nanotechnology (SPRING) was conceived as a means of strengthening research infrastructure at Texas Universities. The particular emphasis was on tools and facilities to enhance the nanoscale science and engineering research capabilities of those universities, improving the ability of investigators to support projects in concert with DoD and AFML/AFOSR research goals. In its first year (SPRING I, AFOSR F49620-03-1-0374) Rice University's component of support was used to acquire a variety of tools for use in a new cleanroom facility. These tools included an electron beam evaporator, a photolithography mask maker, a photolithography mask aligner and exposure tool, plasma-based deposition and etching systems, and additional characterization tools.

Our SPRING II (AFOSR FA9550-04-1-0328) activities involved the purchase of one additional equipment item (a wafer dicing saw) for the use in the Rice Nanofabrication Facility. The class 100/1000 clean room was dedicated on May 20, 2004 and has been in operation now for three years, with over 90 users already trained on overall operation as well as the detailed use of all the processing equipment. Other major equipment acquired through this FY04 grant includes two new TEMs, for use by researchers from all areas of science and engineering, as well as other SPRING partners. The major purchases made were two transmission electron microscopes (TEMs), one for high resolution materials characterization, and one for the study of biological samples. Additional items included a sputter coater for TEM sample preparation, a cryogenic NMR probe for improved characterization of chemically synthesized materials, and an upgrade to the shared SQUID magnetometer for better assessment of magnetic materials. A six (6)) month No Cost Time Extension was approved to allow final receipt and payment for a cryo TEM sample holder and and a surface analyzer (for determining the surface area of nanomaterials), along with the final tabulation of costs for the travel to the annual SPRING Research Conference.

All such shared infrastructure at Rice University is administered by the Shared Equipment Authority, a university committee consisting of fifteen faculty members from across the natural sciences and engineering. The SEA sets user policies and fees, and supervises salaried technical staffs that train users, assist in research, and maintain the shared instrumentation. The SEA ensures that infrastructure purchased under the SPRING program is utilized efficiently and in support of the maximum number of researchers. External industrial and government users also have access to all such equipment at appropriate rates. Twenty-nine companies now have equipment usage agreements with the SEA, indicating that the upgraded infrastructure at Rice is indeed enabling expanded R&D in nanotechnology in the Houston area and beyond. The SEA has been the mechanism by which Rice's nanoscience infrastructure needs have been assessed, and has determined the recommended purchases of instrumentation under the SPRING program.

Results

Item	Vendor	Price
TEM GIF, X-ray, Scanning accessories	JEOL	$81,560
X-Ray Facilities Upgrade	Various	$138,694
Mass Spec – MALDI and ESI-TOF	Bruker, ThermoElectron, MassTech	$1,326,451
Electrokinetic Analyzer & Zetasizer	Colloidal Dynamics, Malvern	$115,953
TIRF Microscope/NIR Microscope modifications	Zeiss	$180,572
Rapid Prototyping/Engraving Systems	Z Corporation/Universal Laser	$117,193
AFM upgrades	Veeco	$10,149
Vibratome	Leica (Meyer Instruments)	$11,288
Travel/SPRING meetings		$18,140
	Total:	$2,000,000

Publications

Since the financial resources of this grant were not allocated to the direct funding of specific research projects, there is not a list of publications, talks, and patents funded by this grant. However, this research infrastructure supports over 120 faculty members from 16 departments, as well as external users throughout the Houston area.

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Dr. Wade Adams
Director, Smalley Institute of Nanoscale Science and Technology